RB 503 RB 504
RB 503T RB 504T

737-022

instruction manual

RB-500 Series

Models: RB-503T & RB-504T

NORTH ATLANTIC
industries, inc.

ratio boxes

Ratio Box

RB-500 Series

MODELS

RB-503T, RB-504T

North Atlantic Industries, Inc.

Plainview New York

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INSTRUCTION MANUAL SUPPLEMENT

RB-503, RB-504
RB-503T, RB-504T

In all instruments after Serial No. 6000, the following applies:

N.A.I. #800941 - Knob, GEE-LAR #J-385 or equal has been replaced by N.A.I. #201979.

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SPECIFICATIONS/ (Preliminary - Subject to change without notice)

	RB-503T		RB-504T	
	Isolated	Direct	Isolated	Direct
Ratio Range	±1.111110	0.000000 to +1.111110	±1.111110	0.000000 to +1.111110
Accuracy @ 400~ (Terminal Linearity)	10ppm	10ppm	3.0ppm	1.0ppm
Frequency Range	50cps to 3KC	50cps to 5KC	50cps to 3KC	50cps to 3KC
Voltage Rating (f in cps)	.35f to 350V Max.	.35f to 350V Max.	.35f to 350V Max.	.7f to 350V Max.
Input Impedance at 400~	> 10K	300K	> 10K	> 200K
Nominal Output Resistance (Max*)	5.2 ohms	3.5 ohms	10 ohms	8.5 ohms
Resolution	5 Decades + Potentiometer (0.3 ppm)			
Phase Shift	Less than 1 minute			
Switches	Heavy Duty			
Size	5 1/4" Standard 19" Panel (Behind panel) 5"H x 17 1/4" W x 9" D			
Weight	40 lbs.		42 lbs.	

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GENERAL DESCRIPTION:

The RB-503T and RB-504T incorporate the features of the high accuracy of the standard ratio box RB-500 series and the North Atlantic Model T-120 Precision Inversion Transformer. This combination provides a complete range of ratios from -1.111110 to +1.111110, as well as signal isolation. The RB-503T and RB-504T can be converted to a standard ratio box merely by switching to the direct position. This removes the Model T-120 from the input.

OPERATION:

1. Connect input to "In" and "COM" terminals (see specifications for max. input voltage).

2. Select desired input:

    a. +, - (isolated input). Connect low side of output to ground terminal lug.
    b. DIRECT- Connect low side of input to ground terminal lug.

3. Read output from "OUT" and "COM" terminals.

4. In "DIRECT" position both "COM" terminals are connected by large, low resistance wire to guarantee minimum degradation of accuracy due to line loss.

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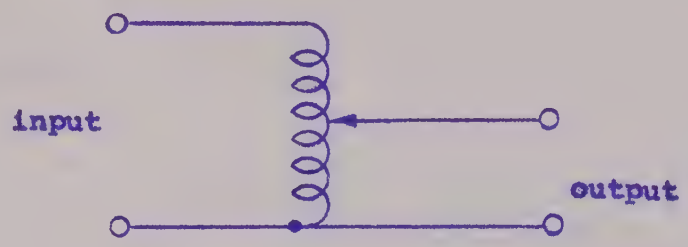
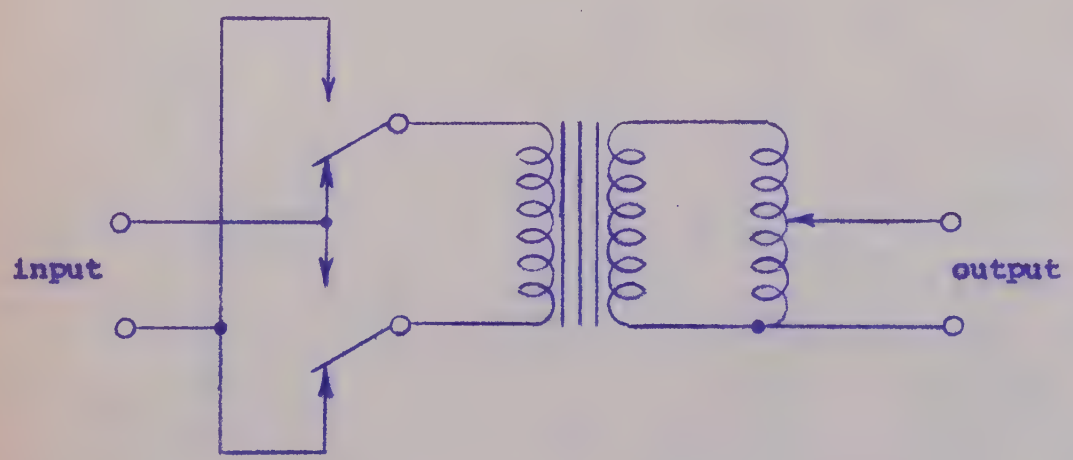


Direct



Isolated

Fig. 2 Schematic RB-503T, RB-504T

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APPLICATIONS:

The RB-503T and RB-504T Ratio Boxes are ideal for the precision calibration of resolvers and synchros where minimum loading, high accuracy, and low phase shift are essential. They also eliminate the need for re-arranging the test setup or providing additional inversion switching within the test set. In these and other applications, use of the ratio boxes in conjunction with North Atlantic's Phase Angle Voltmeter* permits rapid, direct reading of nulls, phase shift angle, and quadrature voltage.

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SUMMING NETWORK TECHNIQUE

In Figure 3 the output of the test piece is arranged to have a polarity opposite to that of the ratio device. By means of precision summing resistors-available from NORTH ATLANTIC as the P202 PLUG-IN SUMMARY MODULES, the outputs are added. At null the ratio device will then read the in-phase ratio of the item under test. In this particular test set up a line isolation transformer is utilized so as to avoid grounding one side of the line. For illustrative purposes the NORTH ATLANTICP-201 PLUG-IN REFERENCE ISOLATION MODULE is also shown as providing circuit isolation on the reference input. This feature can also be built into the voltmeter.

In using the circuit of Figure 3, care should be exercised in evaluating the errors which can arise due to loading of the test piece by the summing resistors and inaccurate summing due to test piece source impedance.

Phase angle is easily measured using the technique shown in the following section for small angle measurement. Allowance must be made in this case for the 2:1 change in voltmeter sensitivity resulting from the summing network.

II. BRIDGING TRANSFORMER TECHNIQUE

For greater accuracy, the circuit of Figure 4 has found wide acceptance where the requisite polarity arrangement is feasible. In this case, matching of the test piece output to the ratio device is achieved by using a bridging transformer. A NORTH ATLANTIC P203 BRIDGING TRANSFORMER MODULE is shown, although any good double-shielded isolation transformer with suitable common mode rejection and low input capacitance would suffice.

Measurement errors in Figure 4 can occur due to capacitive loading of the test piece or capacitive coupling of the common mode signal into the secondary. The former can be minimized where shielded cables are used by using the so called "driven shield" technique shown in the figure.

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Common mode rejection is a function of the transformer shielding, the impedance level of each input to the transformer and the relative values of these impedances. Each set up must be judged by itself as to its suitability for a particular measurement.

Phase angle again is easily measured using the small angle measuring technique shown in the following section. Here allowance must be made for the bridging transformer transformation ratio (1:1 for the NORTH ATLANTIC P203 MODULE).

Both of the above measuring systems are used to provide a direct reading of in-phase ratio. Transformation ratio is by definition the ratio of the absolute magnitude of the secondary to primary voltage. To obtain "transformation ratio" the "in-phase" ratio must be divided by the cosine of the phase shift angle.

Maximum accuracies for both set-ups require that the phase dial be adjusted to compensate for residual phase shifts arising from the various transformers in the system, etc. This is conveniently done by stepping the ratio device and adjusting the phase dial to produce zero output when the function selector is in the 90^{o} position. Operation will then be correct when the function selector is returned to the 0^{o} position.

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TRANSORMATION RATIO MEASUREMENTS

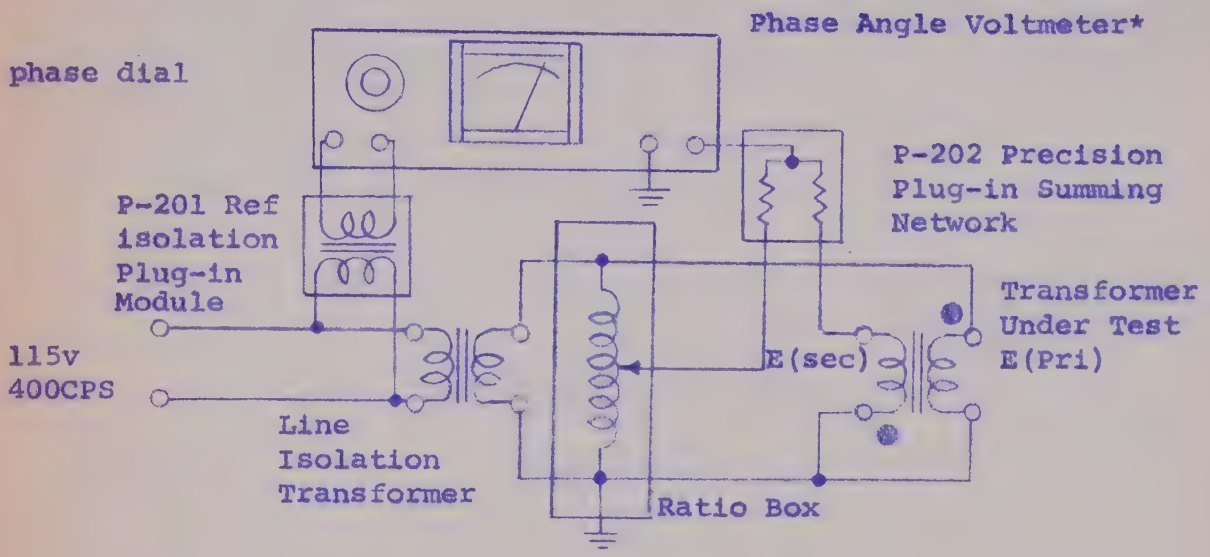

Fig. 3 Parallel Summing

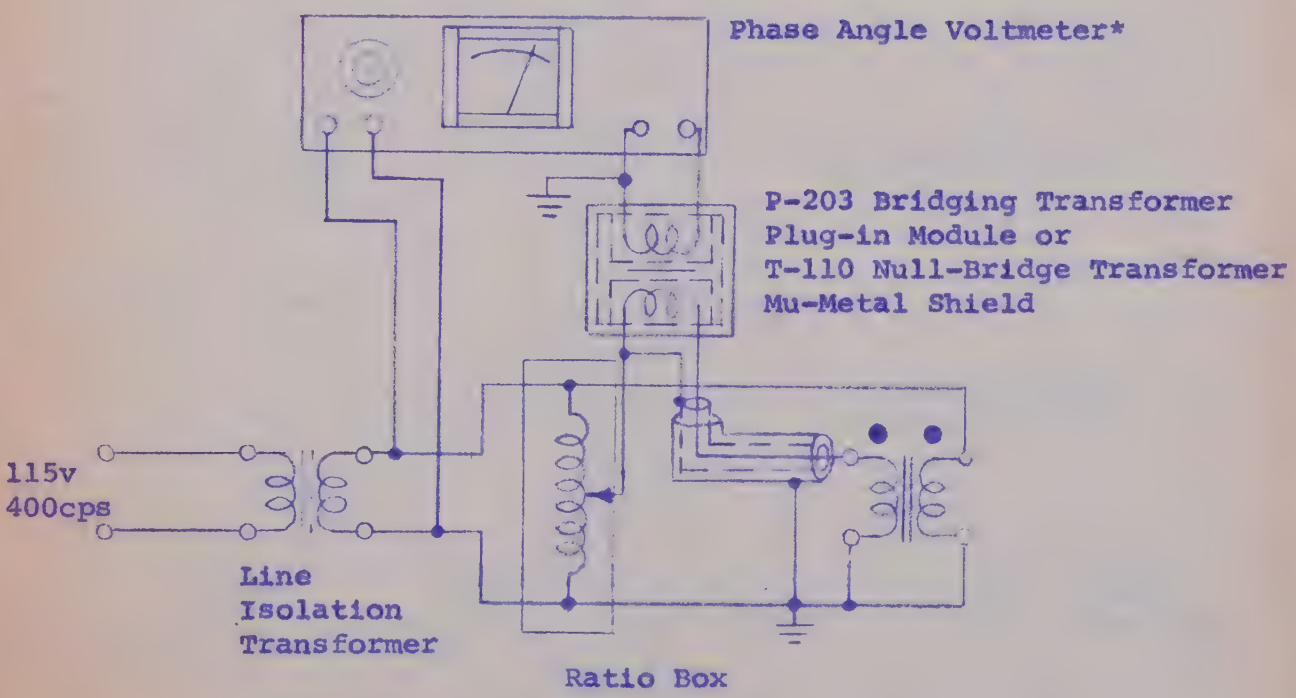

Fig. 4 Series Summing

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PRECISION RATIOMETER

In many analogue computer systems the process of multiplication, division, addition, and subtraction is accomplished using precision potentiometers, or resistors. Those applications involving extremes of precision must be concerned with the distributed capacitance of the ciruit element. Ordinary nulling system, for example, will not permit the manufacture of very precise resistors because of the errors masked by quadrature signals. The circuit of Figure 5 permits precise zeroing of pots or matching and calibration of resistors and potentiometers independent of stray capacitances, or harmonics in the signal source

*Phase Angle Voltmeter

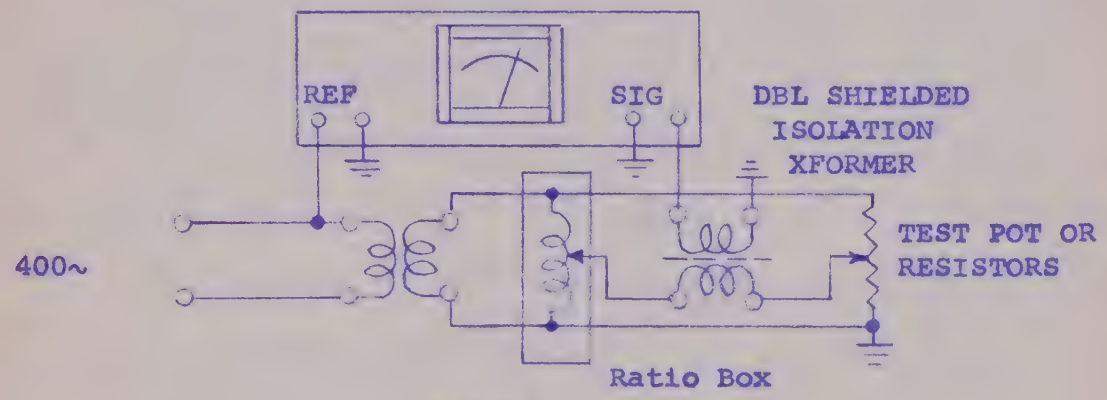

Fig. 5

Two isolation transformers are actually not necessary. If the source is to be isolated then an inexpensive transformer can be used. If the outputs are to be isolated then a low capacitance transformer such as a North Atlantic T-110 should be used. An alternate arrangement would be the circuit of Figure 6, which uses a summing network.

Phase Angle Voltmeter*

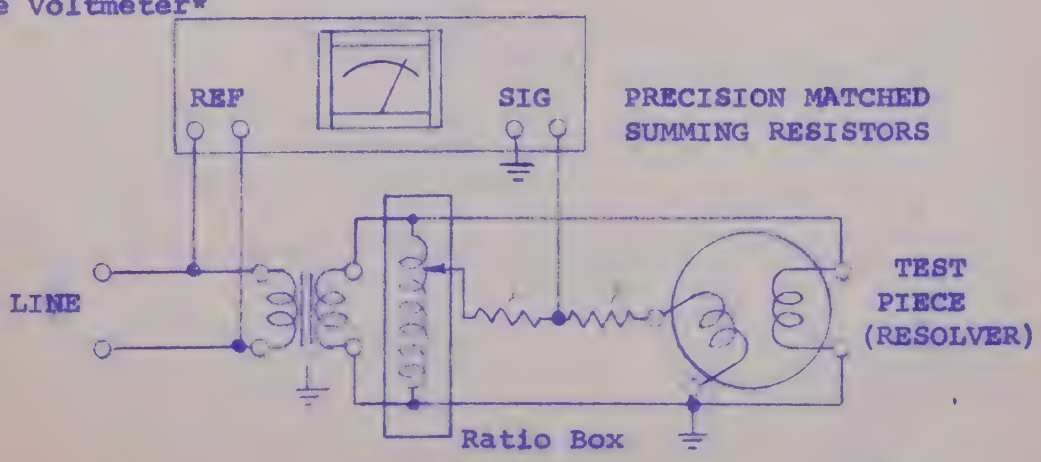

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Fig. 6

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REPLACEMENT PARTS LIST

NAI Part No.	Description	RB-503T	RB-504T
D-500063	Switch, 1st Decade		1
C-500064	Switch, 2nd and 3rd Decades		2
C-500065	Switch, 4th and 5th Decades		2
C-500066	Switch, 4th and 5th Decades	2	
C-500067	Switch, 1st Decade	1	
C-500068	Switch, 2nd and 3rd Decades	2	
B-500023-1	Dial, Assembly, 0 thru 10, graduated	1	1
B-500023-1	Dial, Assembly, 0 thru 10, ungraduated	5	4
B-500023-3	Dial, Assembly, (Red) thru 10		1
C-200380	Window	1	1
B-800568	Rheostat (last digit)		1
B-802616	Rheostat (last digit)	1	
	Fuse (output) 1 amp. Littelfuse #312005 or equal	1	1
C-200215	Ratio Transformer, 1st Decade		1
C-200214	Ratio Transformer, 2nd Decade		1
C-200208	Ratio Transformer, 3rd Decade		1
C-200210	Ratio Transformer, 4th Decade		1
C-200211	Ratio Transformer, 5th Decade		1

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NAI Part No.	Description	RB-503T	RB-504T
C-201792	Ratio Transformer, 2nd & 3rd Decades	1	
C-201793	Ratio Transformer, 4th & 5th Decades	1	
800941	Knob, GEE-LAR #J-385 or equal	6	6
801877	Switch, Polarity	1	1
405051	Precision Inversion Transformer T-120	1	1

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CAUTION

High voltage exists at several points in the instrument. Normal precautions consistent with good practice should be taken to reduce shock hazard.

A potential shock hazard exists when ungrounded power source or ungrounded case operation is employed. Persons operating the instrument should be made aware of and take precautions against this condition.

North Atlantic Industries, Inc. cannot be held responsible for damage to person or property in the process of or as a result of maintenance, calibration, or setting up of the instrument.

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WARRANTY

North Atlantic Industries, Inc. warrants its products against defects in material and workmanship for one year from the date of the original shipment. Our liability is limited to repairing or replacing products (except fuses and electron tubes) which prove to be defective during the warranty period.

North Atlantic Industries, Inc. is not liable for consequential damages or for any damage or injury to persons or property resulting from the operation or application of any of its equipment.

Warranty is voided if there is evidence that the product has been operated beyond its design range, improperly maintained, or physically mistreated.

In the event of a malfunction in a product under warranty, the purchaser should notify his local Sales Representative or the Sales Department of North Atlantic Industries, Inc. giving full details of the defect and providing the model and serial number of the instrument. Service data or shipping instructions will be forwarded promptly. There is no charge for warranty repair of products, except transportation charges.

North Atlantic Industries, Inc. reserves the right to make changes and improvements in its products without any liability for incorporating such changes or improvements in any products previously sold.

No other warranty expressed or implied is offered other than the foregoing.

Estimates of charges for out of warranty repairs or other service work will be supplied before work begins. Out of warranty repairs will only be made following the receipt of purchaser's authorization of applicable charges.

Claims for Damage in Shipment

The purchaser should inspect and functionally test the product in accordance with the instruction manual as soon as it is received. If the product is damaged in any way, including concealed damage, a claim should be filed immediately with the carrier, or, if insured separately, with the purchaser's insurance company.

(turn over for Shipping Instructions)

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Shipping

On products to be returned under warranty, await receipt of shipping instructions, then forward the instrument prepaid to the destination indicated. The original shipping containers with their appropriate blocking and isolating material is the preferred method of packaging. Any other suitably strong container may be used providing the product is wrapped in heavy paper or a plastic bag and surrounded with at least four inches of shock absorbing material to cushion firmly, preventing movement inside the container.

WARRANTY REGISTRATION

Please complete and mail this Warranty Registration Card without delay. Placing this Registration on file with our Service Department will assure that you receive applicable service data as issued. No postage is required. (Mailed on_____ by_____)

WARRANTY REGISTRATION

Date _____

Please register _____

Model No. _____ Serial No. _____

under the terms of the warranty stated in this Instruction Manual.

Name _____

Title _____ Dept. _____

Company _____

Address _____

City _____ State _____ ZIP _____

Calibration and maintenance responsibility has been assigned to the following person and/or department. Address applicable service data to (if same as above, please state):

Name _____

Title _____ Dept. _____

For our information please indicate:

Condition of instrument on receipt _____

Application _____

Will the instrument be: resold as part of a system? _____

maintained as company equipment? _____

SERVICE INFORMATION

This card is provided to aid you in obtaining prompt assistance with questions you may have regarding operation, calibration, maintenance or service parts for your North Atlantic instrument. State information desired and mail. No postage is required.

SERVICE INFORMATION REQUEST

Instrument _____

Model No. _____ Serial No. _____

We require the following service information: _____

_____

_____

_____

_____

Name _____ Title _____

Company _____ Dept. _____

Address _____

City _____ State _____ ZIP _____

Phone _____ Ext. _____

SERVICE INFORMATION

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_____

_____

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_____

Name _____ Title _____

Company _____ Dept. _____

Address _____

City _____ State _____ ZIP _____

Phone _____ Ext. _____

(please send additional Service Information Request cards_____)

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